Advantageously, the core is composed of amorphous metal alloy. This alloy has, in combination, saturation induction that is typically > 1.5 T, high Curie temperature, and very low magnetic core loss. As a result, an ignition core-coil assembly comprising amorphous metal: (i) may be made smaller; (ii) may be located at or near the cylinder head of an operating internal combustion engine; (iii) is able to act reliably in providing real-time cylinder combustion information; and (iv) exhibits improved overall engine efficiency. These benefits endow an ignition system employing the core-coil assembly recited by present claims 1-18 with significant advantageous not obtained by prior art systems, which use either a single ignition coil and distributor, or multiple magnetic cores composed of crystalline material.

Moreover, the present invention provides convenient ways for achieving a core having high flux swing both in gapped and ungapped aspects. An ungapped core having a permeability ranging from about 100 to 300 is readily achieved without the need for gapping. Such a core, as called for by present claims 8-14 and 17-18, is especially advantageous for applications necessitating low radiated electromagnetic (radio) interference and a highly accurate cylinder monitoring capability.

Claims 1 – 18 were rejected as being based upon a defective reissue declaration under 35 U.S.C. §251.

The Examiner has indicated that the reissue declaration filed with the instant application is defective under 37 CFR §1.175 (2) because it fails to contain a statement that all errors which are being corrected in the reissue application up to the time of the filing of the declaration arose without any deceptive intention on the part of the applicant.

Applicants respectfully submit that the reissue declaration in fact contains seven (7) statements concerning 7 different errors, each of which avers that the error for which correction is sought did in fact arise without any deceptive intention. These seven (7) statements, which reference individually each and every error for which reissue has been sought, operate collectively to provide the required statement that all the errors for which correction is sought did in fact arise

without any deceptive intention. Each of the errors enumerated by the reissue declaration for which correction is sought, and the corresponding statement in the declaration that the particular error arose without deceptive intent, is set forth below:

ERROR	STATEMENT
Omission of Claim 8	Page 3, first full paragraph, final two lines
Omission of Claims 9-12	Page 3, penultimate paragraph, final line
Omission of Claim 13	Page 4, first two lines
Omission of Claim 14	Page 4, first full paragraph, final two lines
Omission of Claim 15	Page 4, final paragraph prior to recitation of claim 15, last two lines
Omission of Claim 16	Page 5, first paragraph, final two lines
Omission of Claim 17	Page 5, second paragraph, prior to recitation of claim 15, last two lines

In view of the above remarks, it is submitted that each of the errors for which correction is sought in the instant reissue application has been accompanied by a corresponding statement that the particular error arose without deceptive intent of applicants; and that these statements collectively satisfy the statutory requirements of 37 CFR §1.175 (2) and 35 U.S.C. §251. Reconsideration of the rejection of claims 1-18 under 35 U.S.C. §251 is respectfully requested.

Claims 8 – 18 were rejected under 35 U.S.C. §251 as being an improper recapture of broadened claimed subject matter surrendered in the application for the patent upon which the present reissue is based.

The Federal Circuit has set forth in the case of In re Clement tests that are submitted to be applicable in the consideration of the present reissue application. The court calls for a two-step test, (i) determination whether, and in what aspect, the reissue claims are broader than the patent claims; and (ii) whether the broader aspects of the reissue claims relate to surrendered subject matter. With

respect to (ii), the Court writes, "To determine whether an applicant surrendered particular subject matter, we look to the prosecution history for arguments and changes made to the claims in an effort to overcome a prior art rejection." In re Clement, 131 F.3d 1469, 45 USPQ 2d 1164 (emphasis added).

Applicants submit that present claim 8, and claims 9-12 dependent thereon, are broader in some respects and narrower in other respects than claim 1 of issued U.S. Patent 5,868,123, whose re-issue is now sought. More specifically, in comparison with the subject matter of original claim 5 (now set forth in independent form as issued claim 1) presently pending claim 8 (i) excludes the compositional limit incorporated from originally presented claim 5 into issued claim 1; (ii) excludes the requirement of heat treatment incorporated from originally presented claim 2 into issued claim 1; (iii) adds a requirement that the core be non-gapped contained by originally presented claim 6 but not contained by issued claim 1; and (iv) adds a requirement that the core have a permeability ranging from about 100 to 300, the requirement being not present in issued claim 1.

The prosecution history of the '123 patent includes an Office Action dated March 31, 1997 which indicated that original claims 5 and 8 were objected to as depending from rejected claims but would have been allowable if written in independent form. Original claim 5 depended from original claim 2, which, in turn, depended from original claim 1.

Subsequent to the Office Action, a telephonic interview was conducted on June 18, 1997 during which Examiner Argenbright and applicants' attorney of record, Mr. Buff, agreed on a proposed amendment in which original claim 1 was modified to incorporate therein the limitations of original claim 5. The changes were entered by way of an Examiner's Amendment, after which the case was allowed. An amendment after allowance was filed on August 19, 1997, so as to comply with the Examiner's requirement by providing a formal drawing depicting Figs. 4a and 4b and amending the specification to reference the subject matter incorporated in the newly submitted drawing.

Significantly, the Examiner's Record of the telephonic interview conducted June 18, 1997 indicates that no prior art references were discussed. It is thus respectfully submitted that the subject matter of original claim 5 was never amended or restricted to overcome prior art to obtain its allowance, the claim having been objected to, but indicated as being allowable if re-written in independent form. As acknowledged by the Examiner, applicants made no argument on the record that any limitation added to the originally filed claims was made for the sake of overcoming prior art. Applicants thus submit that while present claim 8 is broader in certain respects than issued claim 1, the broadening is not germane to any prior art rejection of original claim 5, there having been no such rejection, so that the recapture rule does not operate to bar any broadening in present claim 8. That is to say, the broadening of presently pending claim 8 is not the recapture of material surrendered for the sake of patentability, nor was its surrender ever required as a predicate for patentability. Absent evidence of narrowing, it is submitted that reissue is proper. In re Willingham, 282 F.2d 353, 127 USPQ 211, 215 (C.C.P.A. 1960).

Applicants' present claim 13, and claim 14 dependent thereon, are submitted to be broader in some respects and narrower in other respects than claim 1 of issued U.S. Patent 5,868,123, whose re-issue is now sought. More specifically, in comparison with the subject matter of original claim 5 (now set forth in independent form as issued claim 1) presently pending claim 13 (i) broadens the compositional limit incorporated from originally presented claim 5 into issued claim 1; (ii) includes the requirement of heat treatment incorporated from originally presented claim 2 into issued claim 1; and (iii) adds a requirement that the core have a permeability ranging from about 100 to 300, the requirement being not present in issued claim 1.

As set forth above in connection with present claims 9-12, applicants respectfully submit that the subject matter of present claim 13 is not broadened in any aspect germane to a prior art rejection of the subject matter of original claim 5 (now set forth in independent form as issued claim

1), there having been no prior art rejection of original claim 5. Accordingly, it is submitted that the recapture rule does not operate to bar reissue of present claims 9-12.

Applicants submit that present claims 15 and 16 dependent thereon, are broader in some respects and narrower in other respects than claim 1 of the '123 patent. More specifically, in comparison with the subject matter of original claim 5 now set forth in independent form as issued claim 1, presently pending claim 15 (i) broadens the compositional limit incorporated from originally presented claim 5 into issued claim 1; (ii) excludes the requirement of heat treatment incorporated from originally presented claim 2 into issued claim 1; (iii) adds the requirement that the core be non-gapped contained by originally presented claim 6 but not contained by issued claim 1; and (iv) adds a requirement that the core have a permeability ranging from about 100 to 300, the requirement being not present in issued claim 1.

The considerations set forth above in connection with present claims 9-12 are equally applicable for present claims 15 and 16. No broadening aspect of present claims 15 and 16 is germane to a prior art rejection of original claim 5, there having been no rejection thereof. Accordingly, it is respectfully submitted that the recapture rule should not be applied to bar reissuance of present claims 15 and 16.

Applicants submit that present claims 17 and 18 dependent thereon, are broader in some respects and narrower in other respects than claim 1 of the '123 patent. More specifically, in comparison with the subject matter of original claim 5 now set forth in independent form as issued claim 1, presently pending claim 17 (i) broadens the compositional limit incorporated from originally presented claim 5 into issued claim 1; (ii) excludes the requirement of heat treatment incorporated from originally presented claim 2 into issued claim 1; and (iii) adds a requirement that the core have a permeability ranging from about 100 to 300, the requirement being not present in issued claim 1.

As set forth above in connection with the rejection of claims 8-16 under the recapture rule, applicants respectfully submit that the subject matter of claims 17 and 18 is not broadened in any aspect germane to a prior art rejection of original claim 5 now incorporated in independent form in issued claim 1, there having been no prior art rejection of the subject matter of original claim 5. Applicants thus submit that present claims 17 and 18 should not be subject to application of the recapture rule.

In view of the foregoing remarks and the file history of the '123 patent, applicants respectfully submit that none of present claims 8-18 delineates any aspect germane to a prior art rejection of the subject matter of original claim 5, which is now set forth in independent form as issued claim 1 of the '123 patent.

Accordingly, reconsideration of the rejection of claims 8-18 under 35 U.S.C. §251 as being an improper recapture of subject matter surrendered in the course of prosecution of the '123 patent is respectfully requested.

Claims 15 – 16 were rejected under 35 U.S.C. §103(a) as being unpatentable over U. S. Patent 5,377,652 to Noble et al. in view of U. S. Patent 4,502,454 to Hamai et al.

Noble et al. discloses an ignition and engine control system for an internal combustion engine including a fly-back ignition transformer, which can rapidly re-fire a spark plug during a combustion cycle to perform various ignition diagnostic procedures using the spark plug as a feedback element of the control system. Figure 6 of the Noble et al. patent is a perspective view of a transformer core of the invention said to be substantially cylindrical and to include an air gap extending the length of the core. The required retentivity of the transformer core is said to be a very small percentage of its maximum flux density (col. 10, lines 27-28). One form of core suggested is made of METGLAS produced by AlliedSignal Corporation and sold as Alloy 2605TCA. The core is disclosed to have an overall length of about 3.15 inches, an outer diameter of about 0.67 inches, an inner diameter of about 0.48 [inches] and to include an air gap about 0.005 inches wide (col. 12,

lines 38-43). Noble et al. does not disclose or suggest whether the 2605TCA material was used in the as-furnished state or was given any heat treatment.

Noble et al. clearly does not disclose a non-gapped core, nor is one suggested. Moreover, Noble et al. teach low retentivity as a core requirement (col. 10, lines 26-28). It is known in the art that introducing a gap in a toroidal core of the type shown by Fig. 6 of Noble et al. lowers the core's retentivity and permeability. Significantly, Noble et al. does not suggest means for lowering retentivity other than gapping. Accordingly, there is no disclosure or suggestion by Noble et al. concerning a magnetic core coil assembly that generates an ignition event in a spark ignition internal combustion system and comprises a non-gapped core, as required by present claims 15 and 16.

The Examiner further cites Hamai et al, which discloses an ignition system for a multi-cylinder internal combustion engine comprising a plurality of ignition coils and plugs, one of each being provided for each cylinder. Figures 14-16 of Hamai et al. are said to disclose a segmented and non-gapped core.

Hamai et al. describe the structure depicted by Figs. 14-16 as being constructed using an I-shaped iron core made up of a T-shaped iron bar (219) and a straight iron bar (220) in combination. Rounded edges 219a and 220a of the cross-bars of the I-shaped core engage grooves 223a on the inside surface of cylindrical yoke 223. Hamai et al. does not disclose or suggest a core comprising amorphous metal. Applicants respectfully submit that the Hamai et al. core construction, as depicted by Figs. 14-16 is in actuality a gapped core construction when examined in light of criteria set forth in the specification of applicants' patent. (See col. 2, lines 57-67, of the '123 patent). The structure suggested by Figs. 14-16 of Hamai et al. has a plurality of discrete magnetic components, viz. T-shaped bar, straight bar, and cylindrical yoke. Even after assembly, the Hamai et al. core is clearly shown to retain joints at those locations where the components meet. Each of the joints provides a discrete magnetic discontinuity, which feature is defined by applicants' specification to be characteristic of a gapped core (see col. 2, line 57 of the '123 patent). The flux path in the Hamai

et al. core (denoted as Φ in Fig. 16) is depicted as traversing the joints or junctions between the various components. It is well recognized in the art that even a very small discontinuity such as that of the gaps in the Hamai et al. structure will significantly affect the apparent permeability and retentivity of a core made with high permeability material. Even the gap suggested by Noble et al. is only 0.005 inches. By way of contrast, the non-gapped cores of the present invention possess no such discontinuities. For example, no discontinuities are present in a toroid made by tape-winding amorphous metal ribbon or by stacking washer-like rings. Such structures are exemplary of the non-gapped core delineated by present claims 15 and 16. Applicants thus respectfully submit that both the Hamai et al. and Noble et al. disclosures suggest use of gapped cores, and as such, cannot be fairly construed as suggesting a non-gapped core as required by applicants' present claims 15 and 16.

Even assuming, arguendo that the Hamai et al. core were non-gapped, there would exist no motivation to combine the Hamai et al. disclosure with the Noble et al. teaching. As previously noted, Noble et al. disclose use of a low retentivity, gapped magnetic core in a flyback transformer. Neither of the Hamai et al. and Noble et al. references discloses any means other than gapping for obtaining a low retentivity core. Hamai et al. does not disclose that low retentivity is a characteristic of any core. One skilled in the art would clearly regard any Hamai et al. non-gapped core as not having low retentivity, and would be led away from using it to satisfy the low retentivity requirement for a Noble et al. core. Substitution of one of the Hamai et al. non-gapped cores for the gapped core of Noble et al. core would thus render the combination device inoperative for use in a fly-back transformer of an ignition system. It is therefore submitted that there exists no suggestion to combine the Noble et al. and Hamai et al. references to render obvious present claims 15 and 16. In re Gordon, 733 F.2d 900, 221 USPQ 1125 (Fed Cir. 1984).

In the present Office Action it is indicated that motivation for combining the Noble et al. and Hamai et al. disclosures is extant, since gapped and non-gapped cores were said to be well known in

the art as design equivalents. Applicants respectfully traverse the position thus taken. Support for applicant's position is provided by the teaching set forth in Soft Magnetic Materials: The Vacuumschmelze Handbook, edited by Richard Boll, which is representative of the art. A copy of pages 60-63 thereof is provided for the convenience of the Examiner. This disclosure states: "Most magnetic characteristics undergo major change if an air gap is introduced into the magnetic circuit, or if a change-over is made to open specimen shapes, for example, strips or rods" (§4.2.2, p. 60). Lowered retentivity and apparent permeability have long been recognized to be among the magnetic properties most profoundly altered as a result of gapping. It is further known that the influence of gapping increases in direct proportion to an increase in the inherent permeability of the core material. That is to say, the magnetic properties of a core are dominated by the effect of the gap even for very small gaps if the core is composed of very high permeability material, such as the METGLAS TCA alloy disclosed by Noble et al. This material is known from catalog to have a maximum magnetic permeability that is typically 40,000 – 50,000 in the as-furnished state. That permeability increases to as much as 500,000 or more after undergoing certain commonly practiced heat treatments; both values are measured in an un-gapped, strip-wound toroidal core.

Moreover, the Boll disclosure indicates that cut, strip-wound, toroidal cores have an air gap whose effective size is about 0.005 – 0.03 mm (0.0002 – 0.0012 inch). It is respectfully submitted that an air gap even this small is known to cause significant changes in the magnetic properties of a core comprising high permeability magnetic material, including especially the properties of apparent permeability and retentivity.

For example, a core having the dimensions disclosed by Noble et al. at col. 12, lines 41-42, with an outside diameter of about 0.67 inches and an inside diameter of about 0.48 inches, has a mean diameter of about 0.575 inches and a magnetic path length of about $\pi * 0.575 = 1.81$ inches. This core, if gapped to 0.0012 inches, would have a permeability of at most about $1.81/0.0012 = 1500$ even if made with a material having an infinite inherent material permeability. If made with

material having a lower inherent permeability, the permeability of the gapped core would be further reduced from 1500. There would be a concomitant reduction in retentivity, which can be calculated only with additional knowledge of the characteristics of the specific material used.

The Boll reference also discloses that there is even an effect resulting from gapping for a core comprising glued laminations packets with ground mating faces [termed EK-cores by Boll]. The effect of the construction method of Hamai et al. is submitted to be a gapping at least as significant as the gapping of Boll's EK cores. The grinding of plane front faces disclosed by Boll results in the possibility that the faces in these cores may be abutted with minimal separation, yet clearly even this extent of gapping is regarded by Boll as causing alteration of magnetic properties. Hamai et al. does not disclose how the mating surfaces of the disclosed cores are prepared, e.g., whether grinding or similar dressing of the mating surfaces was used to minimize the effect of the gap. However, even a preparation as careful as that of Boll would inevitably result in gapping playing a substantial role in the magnetic properties of the cores depicted by Hamai et al.'s Figs. 14-16, including a reduction in the retentivity and permeability thereof. The cores depicted by Hamai et al.'s Figs. 17-18 intentionally contain even larger gaps. For those cores, the reduction in retentivity and permeability exhibited would be significantly greater.

Significant advantages are realized by use of the non-gapped core called for by applicant's reissue claims 15-16 instead of the gapped cores of either Hamai et al. or Noble et al. Leakage flux is inevitable from an operating gapped core and results in significant radio frequency interference and reduction in signal to noise ratio that is essential in the signal transformer function needed to carry out applicants' required sensing of spark ignition condition. Moreover, gapping adds a mechanical process step to core fabrication. The mechanical hardness of amorphous metal, which is markedly higher than that of any comparable soft magnetic material, results in gapping being expensive, low in yield, and not readily automated. As a result, significant advantages accrue from use of a non-gapped core.

Prior to applicants teaching, the art lacked means for making a suitable ignition core that took advantage of the low losses, high Curie temperature, and high magnetic saturation induction exhibited by amorphous metal. More specifically, the high inherent permeability of known ungapped amorphous metal cores precluded the use thereof in ignition systems requiring a fly-back transformer with low retentivity. Only in the light of applicants' own disclosure it become possible to produce an ungapped magnetic core coil assembly for an ignition system, as delineated by present claims 15-16. Even less was it possible, prior to applicants' disclosure, to achieve a permeability of 100-300, as called for by present claims 8-14 and 17-18.

As discussed hereinabove in connection with the rejection of claim 8 as being improper recapture of surrendered subject matter, neither Noble et al. nor Hamai et al., nor the combination thereof, disclose a non-gapped core. Moreover, as also set forth, applicants respectfully submit that there would have been no suggestion or motivation to combine the cited references.

For the reasons set forth above, it is submitted that present claims 15 and 16 patentably define over the proposed combination of Nobel et al. and Hamai et al. Accordingly, reconsideration of the rejection of claims 15-16 under 35 U.S.C. §103(a) as being obvious over the combination of Nobel et al. and Hamai et al. is respectfully requested.

In view of the remarks set forth above, it is submitted that the present application is in allowable condition. Reconsideration of the rejection of present claims 1-18, and allowance of this application, are therefore earnestly solicited.

Respectfully submitted,

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